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AUTHOR Edelman, Murray S.
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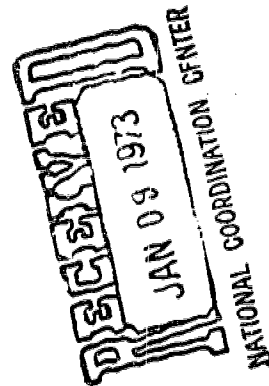
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FINAL REPORT
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PEER GROUP FORMATION IN YOUNG CHILDREN
- PERCEPTION -

Murray S. Edelman
Committee on Human Development
The University of Chicago



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ABSTRACT

This study is an attempt to integrate two theoretical approaches in child development: ethology and cognitive theory. An ethological approach suggests that children structure their social world hierarchically and are emotionally involved in perceiving and participating in interactions involving dominance. It is through this involvement that children may be getting important experience for the development of the cognitive operation of transitivity.

1. Theoretical Approach

A. Umwelt - A basic ethological concept relating the social and cognitive aspects of an animal's behavior to its environment is the Umwelt, i.e. the perceived and conceived world of the organism. An animal's Umwelt includes both the objects and social beings necessary for its survival and reflects the evolutionary process through which the species has become adapted to its own ecological niche (VonUekull, 1925; Omark and Zeigler, 1965).

A distinction such as that between "figure" and "ground" (Goldstein, 1939) is useful for distinguishing those aspects of the Umwelt which are important for the survival of the individual and the species. The "figure" constitutes aspects of the environment which the animal will invariably notice and to which it may have a high emotional response. The "ground," on the other hand, represents the rest of the field of perception and conception which remains undifferentiated.

Chance and Jolly (1970) suggest that one aspect of the adaptation of many primate societies is the persistent attention paid by subordinates in a rank order toward more dominant members. The behavior of dominant members, then, constitutes a figure in the perceptual field of the other animals. This structure of attention, whereby certain animals stand out against the ground of the overall troop movements, has evolved because focusing at common points allows the troop to coalesce during periods of common danger. The evolutionary approach suggests that learning of such attention structures through experience and development has definite survival value for the species.

B. Rationale - In a review of the field studies of primates, Chance and Jolly (1970) have suggested that cooperation and coherence during periods of excitement and danger require a centripetal society, i.e., the lives of individuals are organized with reference to the dominant animal. This form of society was apparently characteristic of early human life in a hunting and gathering society and typifies modern day cultures. Thus, we could expect to find some form of dominance hierarchy among human groups.

Since developing a dominance hierarchy is a basic theme of juveniles in centripetal primate societies, we could also expect that learning dominance relations would be important for human children as well. Many well-defined physical changes have been seen in juvenile primates which make them increasingly capable of inflicting permanent damage upon one another. Thus it is appropriate that they be able to recognize certain dominant individuals and to learn to relate to them in a non-violent manner through the use of gestures and other social signals. Since human growth is similar to that of other primates, the expectation is that it is adaptive for children (as well as for the larger society) to have a coherent view of the dominance relations in their groups since their chance of becoming adults is increased by the ability to anticipate and avoid potentially damaging fights among themselves.

The term "dominance hierarchy" does not refer to a linear hierarchy where there is a clearly defined rank order; it does refer to the dominance hierarchy suggested by Chance and Jolly where dominant animals influence the life of the primate troop and other members of the troop pay attention to them. The study does not suggest that children have a linear rank-ordered conception of their peers, but rather that they are able to use perceived dominance interactions to form conclusions about others whom they did not see interact with one another. In this usage, there is a sense of relative placement in the dominance structure without implying a strictly linear order.

The phylogenetic similarity of a dominance hierarchy in primates and children has important implications for the development of children's logic. Many aspects of behavior and physical structure suggest that ontogenetic change is a basic part of phylogenetic change; phylogenetic similarities in development, therefore, may influence the ontogeny of unique species behavior.¹ Thus the hominid facility with language must have evolved by selection pressure at various stages of primate ontogeny and may be rooted in the analogous dominance structures of human and non-human primates. The emotional involvement children have in playing and competing with each other and the feedback they receive through interaction may have been an important factor in setting the stage for rule-taking and logical operations.

In this study it is suggested that dominance relations among peers are a figure in the child's Umwelt and provide everyday experience which may lead to the development of logic. Obviously the evolution of logic can only be inferred, but its adaptive significance may be seen in children's application of it to their dominance relations with peers. A consequence of this evolutionary approach is that the development of these logical structures may be directly related to physical maturation and to environmentally stable behavioral structures.

Piaget (1965) has provided a useful characterization of the development of children's logical operations. Applying this framework we would say that the Umwelt of the egocentric child (below 7 years) is limited to the perceptual appearance of others in the hierarchy. When paired with another and asked "who's tougher?" he may or may not reply that the other is "tougher." This response may be based on size of the other, or on the anxiety which he may feel when confronted with the other. Because young children's thought is phenomenalistic, they respond only to the immediate appearance of others; their response is not decentered from their own perspective.

School age children (7-11 years) have Umwelten which contain previously observed relationships organized into a coherent system. Because these actions are 'decentered' from their own point of view into an objective system, children are able to act in terms of these structured relationships. With their coherent view of the dominance relations in their group, they do not have to fight with each member in order to know their own position in the hierarchy.

C. The Study - In studying an animal's Umwelt, an adaptation model is basic to ethology. However, the methodology of questioning subjects is new to the field because of the past impossibility of interviewing animal subjects. This study has begun developing a methodology of questioning children about their world in the spirit of the ethological methods which detail behavior so that it may be understood and re-examined by others. Simple words, part of the vocabulary of all English speaking children, with clear equivalents in other languages, were used.

Children were asked to compare themselves with others by answering: "Who is the toughest, nicest, smartest?" and "Who has the most friends?" Prior pilot work indicated that children meant by "toughest" the equivalent of what primatologists meant by "most dominant." Other dimensions were used as comparisons to "toughest" and to provide insights into other aspects of dominance. Because of the aforementioned prominence of the dominance hierarchy in the social life of the group, it was hypothesized that children would have a significant amount of agreement among themselves as to who were the "tougher" children in the class. It was expected, too, that the children would show more agreement in this dimension than in the others they were questioned about.

In addition, the literature on primate social life indicates that a well-developed hierarchical structure is common among males but not among the females in primate groups: hence, more agreement among pairs of boys as to who is "tougher" than among pairs of girls would be expected. Conversely, since Chance and Jolly (1970) emphasize that persistent attention is paid to dominant members by all other members of the group, there should be no sex difference on how well children can accurately perceive the "tough" children in the class.

On the basis of changes of Umwelt suggested by Piaget and correlated maturational changes, we could expect that children in kindergarten would not have a high agreement on dominance relations because they were unable to organize and integrate previous experiences. However, in the first grade there should be a large jump in agreement between children on who is "tougher," since they are beginning to distinguish their points of view from other's and their developing logic obviates the need to fight with each member to know their position in the class.

An important aspect of the study, then, is the integration of Piaget's theory of logical structures with an evolutionary perspective to provide a more comprehensive theory of development than that currently available. Piaget's model is useful for characterizing the stages of children's logic, but his equilibration model of development, based on his experiments, is not directed toward answering specifically "what real-life experiences constitute the medium through which a given equilibration process proceeds." (Flavell, 1963). Piaget's model implicitly assumes that the child is in a continuous Piagetian experiment because there is no attempt to translate the general principles of development into specific real-life situations.

Because Piaget (1971) explains development in general terms such as "assimilation" and "accomodation" while ignoring specific hereditary transmissions, he neglects the possibility that some aspect of the environment important for the survival of the species may be learned more easily than others. Since he makes no distinction between the figure and ground in a child's Umwelt, Piaget has no model for suggesting which everyday experiences are emotionally significant and are remembered by children. In trying to organize and understand personally meaningful experiences children may be getting sufficient stimulation to develop conceptual structures through some form of equilibration process.

This study should be seen as an integration of the two theoretical approaches to the study of children rather than a demonstration of the primacy of one over the other. It does not try to show that logical concepts are learned first in the social world; instead the main thrust of the study is to demonstrate that a child's social world is structured in such a way as to provide important experiences for the development of logical operations. A future study may then be concerned with distinguishing between favorable and unfavorable conditions for the development of logical operations. (This type of distinction is now being done for an infant's concept of object permanence and person permanence (Bell, 1970).

II. Methodology

The hypotheses discussed above were tested using three tests specifically developed for this study, and administered to seventeen classes in a private, middle class school. The Photograph Hierarchy Test was given to two nursery school and four kindergarten classes. The Cluster Hierarchy Test was administered to three first, four second, and three third grade classes. The Complete Hierarchy Test was given only in first and third grade in May of 1969 and 1970 to six classes that had previously been given the Cluster Hierarchy Test.

In addition to the larger sample base, a smaller sample was studied more intensively to look at the ability to reason about dominance relations. Thirty-five children, taken from the original 17 classes, were given the Cognitive Test of Hierarchization to compare their ability to rank order physical objects. This empirical comparison between "hierarchization" and "seriation" allowed for a more general integration of Piaget's theory with the evolutionary perspective.

A. Hierarchy Tests

1. Photograph Hierarchy Test. Approximately one week before the day of testing, the children were individually photographed. On the day of the test, each child was separately taken out into the hall. He or she was shown the photographs of classmates placed horizontally on a bench, and arranged alphabetically by first name.

The instructions were: "I'm going to ask you some questions about your classmates. The first question is about toughness. Now what is another word for 'tough'?" (if the child had trouble answering, he was told "Do something tough.") "Now let us look at the first child in the row.

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If the child is tougher than you, turn his picture over." After the child followed instructions, the experimenter again made sure he understood the question. The experimenter then repeated the question with each picture until he was confident that the child understood the task. Then he said, "now continue on down the row, turning over the picture of each child that is tougher than you."

The protocol was followed for the other dimensions: "nicer," "smarter," "has more friends." The order of presentation was randomized over the classes.

2. Cluster Hierarchy Test. In first grade the class could easily read names, so a paper and pencil version of this test was administered to the class as a group. The children's first names were randomly grouped into clusters of approximately six, the word "ME" inserted in a different position in each cluster, and the integers from 1 to 6 printed a few inches from the cluster of names. The administrator read the names of all the children in the cluster and said, "put your pencil on number 1 and put your finger on the toughest (or nicest etc.) child in the group. Now, keeping the pencil on the paper, draw a line through the person's name." This was continued until all numbers in the group were completed.

Before starting the test, the administrator worked an example on the blackboard. He took care to make sure that all children understood that "ME" referred to the child who was filling out the test.

3. Complete Hierarchy Test. In the paper and pencil version of the Complete Hierarchy Test each child was presented with an 8½" by 11" paper with a list of the class members alphabetized by first names. The instructions were to "look through the list and find the toughest child, put the number "one" next to his or her name and cross out the name. Now look through the list and find the next toughest, etc."

The Tab form of this test was administered in a similar manner, except that the names of the children were on small pieces of paper. Instead of matching numbers with names, the children were asked to order the tabs containing the names of the children.

4. Scoring of the Hierarchy Tests. The following statistics were used to analyze the Photograph and Cluster Hierarchy Tests:

Percent of dyadic agreement--was reached by counting the "dyads of established dominance" (where two children both agree on who is the dominant child in their small group, i.e., dyad) and dividing by the possible dyads from the class.

Percent accuracy of perception--measures the child's perception of dominance in those dyads of established dominance of which he or she is not a member. This is formed by counting the number of correct choices of the dominant child in the dyad of established dominance and dividing by the total number of dyads where choices were made.

The matrix of rank orders in the class developed from the Complete Hierarchy Test was used as a class hierarchy and then broken down into a boys hierarchy and a girls hierarchy. The following two statistics were applied to the three hierarchies for each class:

Intraclass correlation-- is the similarity between more than two raters, and is conceptually similar to the traditional Pearson correlation. It could be thought of as the average correlation of all possible correlations of each member's ranking of the class with every other member.

Attention structure ratio--formed to test Chance's suggestion that the dominant animal is the one who commands the attention of the others. The variance of the "toughest" child's score, computed from all children in the class rating the first child was averaged with the variance of the second "toughest" child's score. The averaged variance of the top two children was then divided by the average variance of the bottom two children to form the attention structure ratio. This ratio from each class is distributed as an F statistic.

8. Cognitive Test of Hierarchization. This test was administered to 35 children: 9 kindergarten, 18 from first grade (from two classes), and 8 from third grade. These children were systematically sampled from the class hierarchy, administered earlier in the year.

The test consisted of two parallel forms: one about people and the other about sticks. The order of administration of each was randomized within each class and the two forms were kept as identical as possible. In the stick form of the test the child was given eight different colored sticks and asked to order the sticks by which was the longest. In the form, he was given eight photographs of the children in his class, including himself, and asked to rank the children in order of toughness.

Later, two hypothetical premises were given. A picture of a girl named Ann was said to be "tougher" than the first child named in the hierarchy and later a boy names Jeffrey was said to be "weaker" than the child at the bottom of the hierarchy. In this hypothetical case a girl was specifically chosen to be "tougher" so that children choosing on the basis of perception would not say that the girl was the "toughest," because children often say "boys are tougher than girls."

A similar look at perceptual illusion (adapted from Smedslund, 1963) was attempted in the stick form by placing an additional short red stick and long black stick with one end of each under a piece of paper. They were placed in such a manner that the red stick which was the shortest actually looked longer than the black stick. The first hypothetical premise was: "suppose you measured the black stick and this stick (1) (examiner pointed to the longest stick in the original rank ordering of sticks), and you found the black stick was longer than (1)." In a second trial the child was told that the shortest stick in the original grouping was longer than the red stick.

Thus, on both forms of the test, the child is confronted with a perceptual illusion. The first two questions on the people form dealt with the hypothetically tougher child: 1) Who was tougher; Ann or the subject? 2) Who was tougher; Ann or the child placed in the second position by the subject? The next two questions dealt with the hypothetically weaker child, Jeffrey: 1) Who was tougher, the subject or Jeffrey? 2) Who was tougher, Jeffrey or the child placed in the second best position by the subject? The last question asked: Who was tougher; Ann or Jeffrey?

The stick form of the test was analogous, except that sticks were substituted for people. A stick placed in the middle position or the original rank ordering served as the hypothetical "object of attention" in lieu of the subject. Thus the child was asked: 1) which was longer, the black stick or the second-longest stick in the original ordering? 2) Which was longer, the black stick or the middle-ordered stick? 3) Which was shortest, the red stick or the seventh-ordered stick? 4) Which was shortest, the red stick or the middle-ordered stick? 5) Which was longest, the red stick or the black stick?

Each question was scored separately. An answer was scored "correct" if the child's answer was consistent with the hypothetical premises. The answer was said to have a transitive justification if the child, when asked "how can you tell?" repeated one of the hypothetical premises or stated an appropriate answer based on the hierarchical ordering he or she had just made.

III. Results and Discussion

The major findings of the study are listed below and briefly discussed.

1. "Toughest" is the most agreed upon dimension between pairs of children and the dimension most accurately perceived by the members of the class.

Since "toughest" is a form of dominance rooted in the everyday experience of the child, it was hypothesized that "tougher" relations would initially be more accurately perceived than other dimensions tested. As can be seen in Figure 1, "smartest" and "toughest" clearly interact with grade level ($F = 4.3, p < 0.0019$), but with "toughest" showing the highest percent of dyadic agreement.

Although "toughest" is higher in the sex pairings in first grade, the difference in second and third grade is due mainly to the fact that boy-girl pairs consistently have a much higher rate of agreement on "toughest" than on "smartest."

Other evidence suggest that "toughest" is an important part of a child's world. The children averaged 75% accuracy of perception in choosing the dominant member in pairs that had established dominance. The intraclass correlation measuring the existence of an agreed upon hierarchy for the Complete Hierarchy test ranged from 0.43 to 0.79; in all classes the correlation rejected the null hypothesis of no hierarchy at the .001 level of significance.

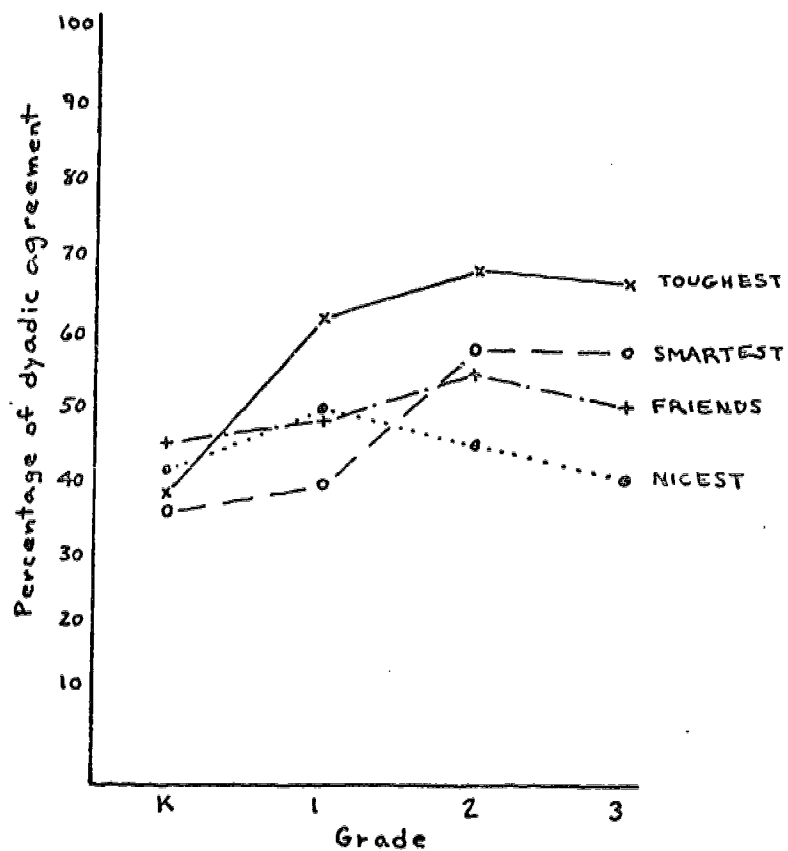


Fig. 1 The estimated percent of dyadic agreement in a class across cross-sex and same-sex pairings for the dimensions "toughest," "nicest," "smartest," and "most friends."

Thus in the early school years, visible physical interactions between children are "figures" in the children's Umwelten. By second or third grade the children are becoming aware of "smartest," but do not seem to agree on the other two dimensions, i.e., 50% agreement on "most friends," and 40% agreement on "nicest" in third grade, possibly because they do not have consistent definitions on which to compare others along these two dimensions or because those are not important aspects of dominance.

Because of the high agreement on "toughest," the rest of the discussion will be confined to results relating to it. The reader is referred to the dissertation for a report of the other dimensions.

2. There is a highly significant developmental trend in dyadic agreement on "toughest" with a large increase between kindergarten and first grade.

The percent of dyadic agreement on "toughest" in Figure 1 has a highly significant linear trend ($F = 79.2, p < .001$) with a large quadratic component ($F = 18.1, p < 0.005$) because of the large jump in agreement from kindergarten (40%) to first grade (62%). This finding on the sample of 17 classes amplifies a similar finding in the small sample of 35 children on the Cognitive Test of Hierarchization. The number of correct answers on the "people" form of the test shows a significant developmental increase ($F = 5.5, p < 0.004$), as does the number of correct answers with a transitive reason ($F = 9.5, p < 0.0002$). In Table 1 it can be seen that the mean number of answers with a transitive reason on the "people" form increases from 0.7 in kindergarten to 3.6 in first grade for the boys, and from 0.0 to 4.0 for the girls. The scores on the stick form of the test show a similar jump between the two grades.

This large increase in percent of dyadic agreement from kindergarten to first grade corresponds to a similar increase on the smaller sample measuring the underlying cognitive level. Children, then, seem to be developing a consistent perception of their dominance structure at the same time they are developing the logical operation of transitivity.

TABLE 1

	Kindergarten		First Grade				Third Grade	
	Boys	Girls	Boys	A Girls	B Boys	Girls	Boys	Girls
Stick Form	1.2	1.7	4.5	2.8	3.3	3.0	4.75	4.5
People Form	0.7	0.0	3.8	4.0	3.2	3.2	4.0	4.25
Number of Subjects	(6)	(7)	(4)	(5.)	(5.)	(4)	(4)	(4)

Standard Deviation: Sticks 1.98
People 1.63

Mean number of correct answers with a transitive reason in each class and sex for the stick form and people form of the Cognitive Test of Hierarchization.

3. There is no significant difference between the way children reason about sticks and the way they reason about people.

The number of correct answers with a transitive justification based on the five questions referring to hypothetical premises, showed no significant differences between the stick form and the people form of the cognitive test on the overall mean score per child ($F=.574$). The scores on the two forms showed equivalent developmental trends ($F=.878$) and did not interact with sex ($F=0.47$). (See Table 1.) These extremely small F values suggest that this result of no significant difference between the two forms probably would hold up in a much larger sample.

The parallels between reasoning about people and reasoning about objects could also be seen in a question-by-question analysis of the people form. The kindergarten children, when asked how they could tell that one child was tougher than another, would use perception-based models of thinking characteristic of those developed by Piaget in children's application of transitivity to objects. An analysis of the answers suggested that Piaget's distinction between preoperational thought and logical operations in the application of transitive reasoning to sticks was similar for the application to people.

The question-by-question analysis, also reveal that there were differences between the two forms of the test, primarily because the people form involved the subject in the premises. For example, as shown in Table 2, the boys, but not the girls, often answered incorrectly when the correct answer was that a hypothetical child was tougher than the subject (47% correct). When the questions involved the emotionally neutral sticks, the boys had not trouble (94% correct). This significant difference ($p<0.05$) appears to be related to the boys tendency to over-rate themselves in comparison with others, as seen in the larger sample.

TABLE 2

	Sticks	People
Boys	0.94	0.47
Girls	0.69	0.69

The proportion of children answering correctly the question requiring the conclusion that the hypothetical child is tougher than the subject, as compared with the matching question on the stick form ($N=35$).

While the evidence indicates that the child's cognitive level with regard to transitivity is equivalent across people and sticks, there are additional factors involved in answering correctly questions involving people. Hence a theory of how children develop the ability to perform logical operations in a real life situation must allow for the differential affects of environment and emotional response.

4. The tougher children are more consistently ranked high than the weaker children are ranked low.

- The hypothesis that there would be more agreement on the tougher children because attention is directed upwards in the hierarchy was significant for the class hierarchy ($F=4.9$, $p<0.04$), almost significant for the boys ($F=3.0$, $p<0.10$), and insignificant for the girls hierarchy ($F=0.91$). From these inconclusive results, it seems that attention structure is more related to the visibility of specific dominant children in a class and hence would be expected to vary from class to class. It was found that half the classes showed a statistically significant relation reflecting higher agreement on the tougher children. Similar suggestive results were found for the boys and girls hierarchy.

A related finding from the question-by-question analysis in the Cognitive Test of Hierarchization, is that the children more frequently answered a question correctly about a hypothetical child who was tougher than all members of the class than they answered a parallel hypothetical question about a child who was weaker than all members of the class ($p<0.025$). It appeared that the children were more able to work with premises about the tougher children than about the weaker children, perhaps because statements about the dominant children were more meaningful to them. These results and the interview data demonstrating that a dominant child was described with greater detail than a weaker child suggests that an important characteristic of the child's world is the differential amount of attention that is paid to the more dominant children.

5. Boys show more agreement as to who is toughest among themselves than do girls. However, there is not sex difference in the accuracy of perception of others.

As hypothesized on the basis of primate studies, boys had consistently and significantly more dyadic agreement on "toughest" than did girls ($F=5.02$, $p<0.036$). Supporting evidence on a partially overlapping sample was that there was significantly more agreement, as measured by the intra-class correlation, among the boys on their own rank order than among the girls on their own hierarchy. In the case of the intraclass correlation, the sex difference was not only statistically significant, but boys had a higher correlation than girls in each class studied in this sample.

Although there were differences in dyadic agreement among the different-sex pairings, there was no difference in the percent accuracy of perception for these sex pairings ($F=1.17$). Similarly, on the partially overlapping administration of the Complete Hierarchy Test, there was no difference on the level of agreement among boys and among girls when rank-ordering the hierarchies of either sex, even though there was consistently higher agreement among each sex group when they were ranking the boys hierarchy.

Not only did boys and girls have a similar level of agreement about their own sex group, the average rank orders produced by each of the sex

groups were highly correlated. The average correlation in a class between the average rank orders produced by the boys and the order produced by the girls when ranking the boys was 0.86 and when both groups rank the girls the average correlation was 0.79.

Thus, although the males are more involved in working out their dominance relationships with each other and hence have a more clearly defined dominance order, the girls can perceive the dominance relations of both boys and girls as accurately as can the boys. This finding supports the parallel to primate social structure suggested by Chance and Jolly (1970), that stable group functioning is dependent upon all members of the group paying attention to the dominant members.

IV. Conclusions

This study has shown that dominance relations between members of a class are an important part of the child's Umwelt and may provide necessary experience for the development of logical operations. "Toughest" relations were the most agreed-upon relations between pairs of children and were the most accurately perceived by class members. The finding that position of the more dominant members was more agreed upon than the position of the less dominant children suggests that particular attention is paid by the children to the more dominant classroom members. Thus, interactions involving toughness and those involving the dominant children constitute a "figure" in the children's Umwelten. Because of the importance of knowing dominance relations, these perceived and experienced interactions may provide the necessary feedback for children to develop logical structures which can organize them.

A related finding was that the ability to organize and perceive dominance relations develops concurrently with the ability to apply logical operations to physical objects. Children gave transitive responses equally well on the "people form" and "stick form" of the Cognitive Hierarchization Test. In addition, both forms showed the same kind of major change between kindergarten and first grade that was seen in the percent of dyadic agreement. Apparently, then, the perception of dominance relations is at least one aspect of the child's real world which provides the necessary experience for the growth of logical operations.

This study suggests that sex differences, usually not found in a Piagetian experiment because of the neutral aspects of the objects, may be relevant to a model incorporating real-life experiencing. Observations on the playground showing sex differences in group size, number of interactions, etc., suggest that the sexes are receiving differing kinds of social stimulation (Omark, 1972). The Hierarchy tests support the notion that boys have a more participatory way of dealing with the dominance hierarchy by continually overrating themselves in relation to classmates. Girls seemed as aware of the hierarchy as the boys, but may be getting their stimulation more through watching others. Since their attention also appeared to be directed toward the dominant members, they may be getting important feedback by watching and reasoning about the more dominant children.

Given the above fit between the logical structures suggested by Piaget and children's conception of their dominance structure, it is possible to apply Piaget's equilibration model of development to the children's experiencing. However, factors such as a child's attention structure may facilitate the development of logical operations but others such as emotional involvement and overrating may complicate the development of logic. Thus a model of the development of logical operations in real life experiencing must include more than the general Piagetian principles of equilibration which were abstracted from specific clinical experimentation.

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